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From Data Silos to Service Efficiency: A Framework for Integrating Local Government Databases to Improve Public Responsiveness

Ginbert A. Fernandez[1] & Leslyn B. Reazol[2*]

[1,2]*Northwestern Mindanao State College of Science and Technology, Tangub City, Misamis Occidental, Philippines.*
[1]*Department of Information Technology, University of Science and Technology of Southern Philippines - Oroquieta, Oroquieta City, Misamis Occidental, Philippines. Corresponding Author Email: leslyn.reazol@nmsc.edu.ph*[*]

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ABSTRACT

This mixed-methods research investigates service inefficiencies within a selected Local Government Unit (LGU) in the Philippines caused by fragmented data infrastructure and persistent data silos, particularly between operational logs and the Community-Based Monitoring System (CBMS). To address these challenges, an integrated data platform was developed, featuring a centralized data warehouse and a standardized data dictionary to create a single source of truth. Multiple Linear Regression (MLR) was applied to the consolidated dataset, yielding a robust predictive model ($R^2 = 0.82$) to support evidence-based resource allocation. Results indicate a strategic reallocation of resources, including a 22% increase in funding for high-impact social welfare programs, enabled by redistributing funds from lower-impact infrastructure initiatives. The findings demonstrate that data-driven decision-making empowers LGUs to shift from compliance-oriented to proactive, needs-based allocation, thus improving service efficiency and public sector responsiveness.

Keywords: Local Government Unit (LGU); Data Fragmentation; Data Integration; Predictive Analytics; Service Efficiency; Community-Based Monitoring System (CBMS); Multiple Linear Regression (MLR); Data Warehouse; Resource Allocation; Data Silos; Evidence-Based Governance; Digital Transformation; Public Sector Management; Data Dictionary.

1. Introduction

The efficient and responsive delivery of public services spanning critical areas like waste management, flood control, transportation, and social welfare is a universal challenge for local government units (LGUs) worldwide. The aim of sustainability and enhanced public service relies on governments transcending basic compliance to attain operational efficiency in resource allocation and service delivery. Global organizations advocate for a strategy focused on a Data-Driven Public Sector (DDPS), emphasizing the importance of developing and delivering services grounded in real data to enhance governmental accountability and optimize resource efficiency. Emphasizing the development of policies grounded in evidence is crucial for ensuring that public resources are directed to areas of greatest need, ultimately fostering both technical and allocative efficiency.

Achieving the goals of a DDPS requires the strategic deployment of advanced information technology, particularly through systems integration, data mining (analytics), and the creation of a centralized data repository. Genuine advancements in improving administrative efficiency, transparency, and cost savings stem not merely from minimizing paper consumption but from the seamless integration of various systems. Furthermore, the contemporary digital transformation involves exploring big data governance and the application of Artificial Intelligence (AI), including predictive analytics, to rethink public administration principles and move from an electronic to a truly digital state. This use of advanced analytics and AI provides high-level justification for optimizing LGU services to achieve greater efficiency and accuracy.

Several countries have demonstrated significant achievements in employing integrated systems and databases to improve governmental decision-making and service efficiency. For instance, studies indicate that integrated

systems are key to creating efficiency, reducing data duplication, and optimizing public services by increasing accessibility and transparency. However, within the Philippines, a recurring challenge is the fragmentation of LGU data silos. Government initiatives recognize this fragmented situation, and while local government units have extensive data, they do not have a unified digital platform to extract actionable insights for development and investment. The issue of fragmented and disjointed local government unit data greatly impacts the efficiency of crisis management and the capacity of local government units to deliver services, as they face challenges due to inconsistent data updates. The issue is exacerbated by the nation's shift towards data-driven local governance and the crucial economic and operational decentralization stemming from the Mandanas-Garcia Supreme Court ruling.

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In spite of the fact that Local Government Units (LGUs) in the Philippines have access to digital solutions and infrastructure, the processes that are required by the bureaucracy may still be exceedingly long in some situations, depending on the circumstances. This reveals that there is a gap between the real experiences that inhabitants have and the technology that satisfies those experiences. The fact that this is the case demonstrates that the gap exists. It is obvious that technical developments on their own will not be adequate to tackle the problem of lagging responsiveness and efficiency. This is due to the fact that there is no framework for predictive optimization. This is shown by the fact that there is simply no framework of this kind. The fundamental reason for the core issue is the challenge of turning data from local government units (LGUs) that are fragmented and not integrated into a strong instrument for strategic and progressive leadership. This is the primary cause of the core problem. The fundamental problem may be traced back to this underlying source. As a result, the purpose of this research is to investigate the difficulties that are associated with fragmented data systems, as well as to design, build, and assess an integrated data framework that makes use of predictive analytics in order to enhance the effectiveness and responsiveness of public service delivery.

1.1 Study Objectives

In order to accomplish this goal, the research will as follows:

1) Evaluate the current state of local government unit (LGU) data systems and the fragmentation of those systems in order to identify key inefficiencies;

2) Design a conceptual framework for an integrated data platform that unifies disparate databases;

3) Develop and validate a predictive analytics model in order to support and optimize budget allocation decisions; and

4) Evaluate the impact of the proposed framework on the accuracy of resource allocation and the responsiveness of public services.

2. Literature Review

Globally, there has been a strong movement towards enhancing the effectiveness and accountability of public service delivery, with digital transformation at the forefront. This shift is championed by international frameworks such as the Data-Driven Public Sector (DDPS), which emphasizes the importance of adopting evidence-based policymaking to improve both governance and resource allocation. Central to this approach is the integration of advanced digital technologies, where the use of information technology (IT) and big data has proven vital for increasing transparency, accessibility, and administrative efficiency in government operations. Research underscores that the transition from traditional to truly digital public administration requires not only technological adoption but also a fundamental rethinking of governance principles and the construction of robust data governance frameworks to ensure the long-term quality, authenticity, and transparency of public data.

A key enabler in this digital transition is the integration of systems and databases within government organizations. Studies have repeatedly shown that integrating data sources reduces duplication, streamlines processes, and improves the quality of decision-making across government programs. Effective IT management that promotes interconnectivity among different data systems is essential for achieving administrative efficiency. However, many local government units (LGUs) still face significant challenges with fragmented data systems and poor interoperability, which can have direct negative effects on service efficiency and responsiveness, especially during emergencies when timely and coordinated action is crucial.

The application of data analytics and integrated information systems has emerged as a critical necessity for supporting evidence-based policymaking. For instance, Valdez and Ramos (2024) demonstrated that the use of a single data repository, integrating sources such as the Department of Social Welfare and Development and the Community-Based Monitoring System (CBMS), significantly improved the effectiveness of resource allocation and government responsiveness. The Philippine Statistics Authority (2025) further highlights the CBMS's crucial role in identifying vulnerable sectors and enabling targeted, responsive interventions, reinforcing the value of accessible, high-quality data for policy and program development.

Beyond analytics, there is growing recognition of the need for data-driven approaches and responsive programming at the LGU level. Barrios (2025) argues that LGUs must develop policies guided by data to efficiently meet their expanded responsibilities under devolution. The CBMS provides a robust platform for this, supporting responsive programming and facilitating integration models that can adapt to local needs. Moreover, emerging research advocates for the use of artificial intelligence (AI) and predictive analytics to further enhance service efficiency and accuracy at the local level (Yusuf, 2023). However, practical obstacles such as infrequent data updates and the absence of centralized platforms continue to hinder LGUs' ability to deliver timely, responsive public services (UPRSPARTA, 2025).

Despite widespread theoretical support for data integration and advanced analytics, there remains a critical research gap in practice. The primary challenge lies in the lack of a predictive optimization framework capable of transforming fragmented and unintegrated LGU data into actionable insights for progressive leadership. This issue is not due to an absence of data or infrastructure, but rather the lack of unified analytical platforms that can harness available information for targeted, data-driven decision-making. As highlighted by Tipanero (2024), addressing this persistent gap requires the design, implementation, and validation of comprehensive integrated data frameworks that incorporate predictive analytics, ultimately enabling LGUs to optimize resource allocation and improve public service responsiveness.

Table 1. Literature Map: Strengths and Weaknesses of Integrated Systems and Predictive Analytics; This table provides a comparative summary of key studies and frameworks related to integrated data systems and predictive analytics in local government. It highlights the primary technological approach or model investigated in each work, the specific contributions or strengths identified, and the remaining limitations or gaps particularly regarding practical integration, predictive optimization, and data-driven decision-making in public sector management.

Author(s) and Year	**Technology/Model Applied**	**Strength (Contribution)**	**Weakness (Gap/Problem)**
Kassen (2022)	Integrated Systems & Databases	Systems integration is key to efficiency, reducing duplication, and improving governmental decision-making.	Data systems are often fragmented and exist in silos, hindering true integration.
Mustapha et al. (2021)	IT Management & Data Integration	Integrates data to optimize public services, increasing transparency and administrative efficiency.	Focus is on administrative efficiency; it does not inherently provide a predictive optimization framework.
OECD (2024)	Data-Driven Public Sector (DDPS)	Provides the international framework for achieving Sustainability and strategic governance through data utilization.	Conceptual: fails to address the local capacity for frequent data updates and subsequent service responsiveness.
Yukhno (2022)	Big Data Governance	Supports the need for advanced study in big data governance to move public administration to a digital state.	Focuses on governance principles, not the practical integration of disparate LGU databases into a single platform.
Yusuf (2023)	Artificial Intelligence (AI) / Predictive Analytics	Provides justification for using AI and predictive analytics to enhance the efficiency, accuracy, and accessibility of LGU services.	High-level justification; lacks a concrete framework for integrating the specific fractured LGU data required for the AI model input.
Valdez & Ramos (2024)	E-SITIO (Data Integration Model)	Offers a practical example of a successful approach to data integration to support evidence-based resource distribution.	The problem of infrequent data updates (which impacts responsiveness) in LGUs still persists, limiting the model's value.

Barrios (2025)	Data-Driven Devolution	Confirms the problem of lagging Responsiveness and Efficiency even in top LGUs, pointing to the need for system optimization.	Validates the problem but does not provide the integrated, predictive solution needed to move beyond mere compliance.
UPR SPARTA (2025)	Data Platform Concept	Directly identifies the problem: LGUs have data but lack a single platform to derive actionable insights for investment.	Pinpoints the problem (lack of a unified platform) but does not offer the developed framework with predictive analytics.
Torres & Cruz (2021)	Data Governance Frameworks	Highlights the critical step of ensuring data quality, authenticity, and transparency for project sustainability.	Focuses on governance; the fragmentation of LGU data systems makes governance difficult in practice.
UNDP (2022)	Data Governance Study (DRR-CCA)	Illustrates the severity of fragmentation and data interoperability challenges, especially in crisis response.	Focuses on disaster response; it does not provide a generalized framework for integrating all LGU databases for all public services.
Tipanero (2024)	Economic and Technical Efficiency Metrics	Provides the definition and metrics for evaluating efficiency, linking it to optimal service delivery and budgetary allocation.	Provides the "why" and "what to measure" but not the "how" (the data framework) to achieve this optimization using predictive models.

3. Methodology

Research Design

This study employs a mixed-methods approach that strategically integrates qualitative policy analysis with quantitative data analytics. The research is conducted within the context of a selected Local Government Unit (LGU) in the Philippines and draws on both primary and secondary data sources to develop the data architecture. Primary data are obtained from LGU-generated records, including financial reports, operational logs, and datasets derived from the Community-Based Monitoring System (CBMS). Secondary data sources consist of relevant government policies and established academic literature on digital local governance.

The research methodology comprises three key stages:

(1) assessing the existing data infrastructure of the LGU to identify fragmentation and data silos;

(2) designing an integrated data platform to consolidate information from multiple sources; and

(3) applying predictive analytics models to support the optimization of budgetary resource allocation based on identified socioeconomic needs.

Current State Data Flow Diagram (DFD)

Figure 1 illustrates the inefficiencies that are inherent in the data management technique that is currently being used. Taking this course of action makes it very clear that in the lack of integration, every system operates independently, which leads to fragmented storage, duplicated data, and the risk of processes that are not operating

properly. In order to create the basis for the execution of prospective upgrades, such as the consolidation of databases or the adoption of an integrated data platform implementation, the graphic provides the necessary foundation.

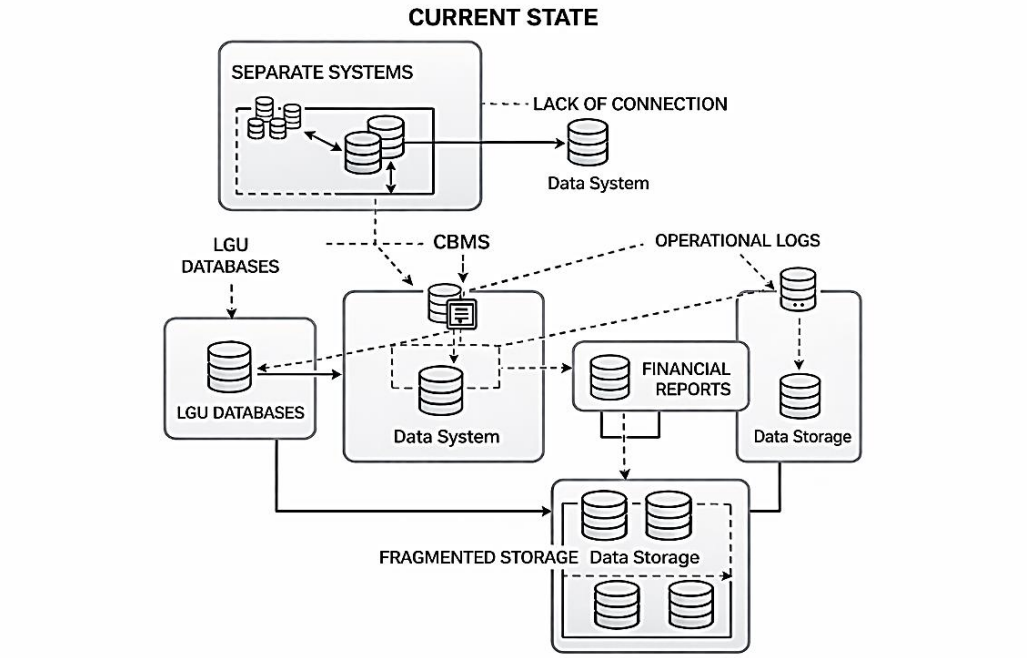

Figure 1. Current State Data Flow Diagram (DFD): This diagram illustrates the inefficiencies inherent in the current LGU data management system, showing how lack of integration results in data silos, duplication, and operational risks. Figure created by the authors.

Proposed System Architecture

Figure 2 is a representation of the planned system architecture that would be implemented inside a Local Government Unit (LGU). A better management of data is the goal of this architecture, which was designed with that objective in mind. At its center is something that is known as an "Integrated Data Platform," which functions as the exclusive and official source of information for the organization. This platform is the foundation of the system. Because the integrated platform is placed at the core of this design, it is possible for the primary functional areas to transmit data in a fluid way. These fundamental functional domains include the Community-Based Monitoring System (CBMS), as well as the Financial and Operational Information Systems. The fragmented and segmented systems that were shown in the image that came before this one are drastically different from this one, which stands in striking contrast to those systems. Arrows that point in both directions are used to illustrate data flows that work in both directions and occur in real time. This not only assures that all of the subsystems draw from the same data source, but it also guarantees that they contribute to the data source. This configuration is advantageous for a number of reasons, including ensuring that the data is consistent, decreasing the amount of duplicate information, and making reporting and analytics easier. The Local Government Unit (LGU) has the ability to enhance decision-making, raise data integrity, and promote operational efficiency across the board by bringing all of the departments' data together on a single, authoritative platform. This will allow the LGU to fulfill its mission.

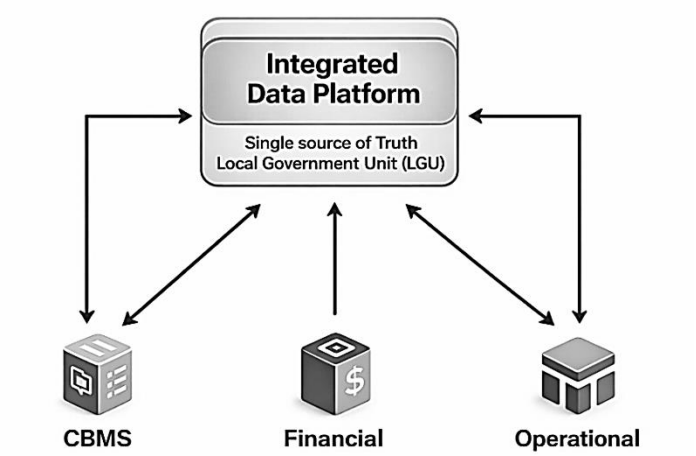

Figure 2. Proposed System Architecture: This diagram presents the planned integrated data platform, highlighting the flow of data among key functional domains (CBMS, Financial, and Operational systems) and demonstrating the benefits of a centralized architecture. Figure created by the authors.

Enhanced Entity-Relationship Diagram (EERD)

An enhanced Entity-Relationship (ER) architecture is shown in Figure 3, which is used for the purpose of providing an integrated data platform for local government units (LGUs). This model draws attention to the phenomena by showing the connections that exist between the several key organizations that are engaged in the process of resource allocation and requirements assessment. LGUDEPARTMENT, SOCIOECONOMICNEED, BUDGETARYRESOURCE, and CBMSDATA are the key entities that are related to one another via the connections "ALLOCATES" and "IDENTIFIES," which are located at the center of the model. These connections are what allow individuals to communicate with one another. It is via the "ALLOCATES" connection that the LGUDEPARTMENT entity is linked to both the SOCIOECONOMICNEED and BUDGETARYRESOURCE entities. This link establishes a many-to-many (M: N) relationship between the three entities. Because of the nature of this link, it is possible to draw the conclusion that the LGUDEPARTMENT entity is the major resource allocator and that it is the store of information that is pertinent to the department. It is a reflection of the fact that departments have the ability to deploy a vast number of resources in order to satisfy a wide range of socioeconomic needs, and that each resource or requirement may, in turn, entail a number of departments. The organizational structure that is now in place is a reflection of this reality. It is the responsibility of the SOCIOECONOMICNEED organization to gather information on the needs of the community, including not only the severity of those requirements but also the recipients who are intended to get them. The BUDGETARYRESOURCE entity, on the other hand, is in charge of documenting funding data such as the amount, the source, and the approval status. This is in contradiction to the previous statement. Using the "IDENTIFIES" connection, the SOCIOECONOMIC_NEED entity is connected to the CBMSDATA object. This connection is between the two entities. A number of granular household-level characteristics, including income, education, and health, are included in the CBMSDATA entity. Due to the existence of this link, it is clear that the socioeconomic needs are determined on the basis of important data received from the community. A resilient and linked system that allows the detection of requirements based on data and the coordinated allocation of resources

is shown in the picture. This is a broad sense of the image. This is a potential that may be considered practical due to the inclusion of data streams from a wide variety of organizations, financial institutions, and the community.

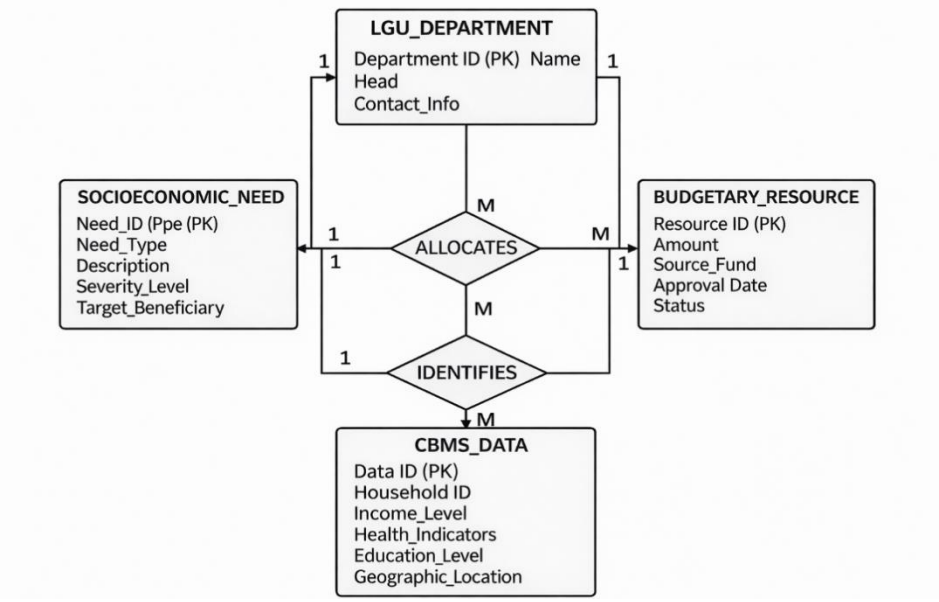

Figure 3. Enhanced Entity-Relationship Diagram (EERD): The EERD depicts the relationships between LGU departments, socioeconomic needs, budgetary resources, and CBMS data, illustrating how integrated data supports resource allocation. Figure created by the authors.

Research Flowchart

The flowchart of the research, which is referred to as Figure 4, presents a visual depiction of a methodical, step-by-step mixed-methods technique. This approach was used in the process of carrying out the study. With the support of this technique, which is designed to make the construction and deployment of an integrated data platform for local government units (LGUs) easier, it is feasible to create such a platform. The first stage of the process is referred to as "Data Collection," and it entails the gathering of primary and secondary information that is essential for obtaining a comprehensive understanding of the present situation. This is the initial step of the procedure that is being carried out. As part of the third step, which is known as the Current State Assessment, an assessment of the disconnected nature of the existing data systems that are used by local government units (LGUs) is now being carried out. Discovering areas that have the potential to be improved, as well as gaps, inefficiencies, and areas that are presently missing, is made possible as a result of this. During the phase that is referred to as "Platform Planning," an integrated platform is built in order to resolve the fragmentation that has been seen and to make the administration of data operations more uncomplicated. It is possible that the input that is provided by this assessment will be beneficial to the Platform Planning phase, which is the phase in which the platform is developed. The method moves on to the succeeding stage, which is the execution of the predictive modeling phase, after the planning phase has been completed and the technique has been completed. In this phase, complex analytics are used in order to simulate and optimize the allocation of the budget based on the integrated data. This is done in order to maximize efficiency. During the time when the phase is being carried out, this effort is carried out. Because of this, it is possible to get insights that are supported by data and that may be used for the purpose of

decision-making inside a company. During the final stage, which is referred to as Policy Recommendations, a full synthesis of all the findings and analytical outputs is carried out. Over the course of this phase, the purpose is to make available to local government units (LGUs) a number of different plans and policies from which they may pick and choose.

Additionally, the flowchart illustrates a feedback loop that starts with the collection of data and goes all the way to the formulation of suggestions for policy initiatives. This sequence of events is shown in the flowchart. In addition to offering light on the repetitive nature of research, this feedback loop also gives insight into the ongoing change that takes place during the process of building policies and procedures. With regard to the broader project, this graphic does a fantastic job of depicting the logical progression and interconnectedness of each study phase that is associated with it. This is accomplished by providing a visual representation of the development of the project. The fact that this is the case ensures that there is transparency and coherence across the whole attempt.

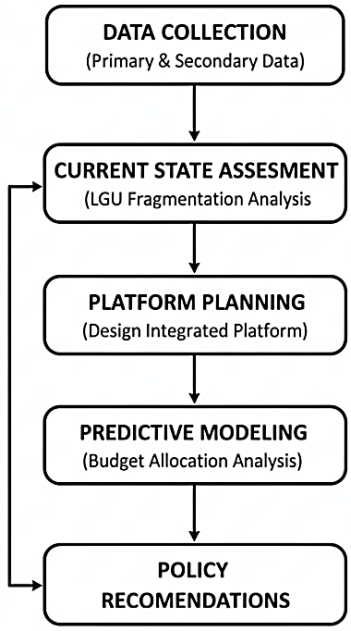

Figure 4. Research Flowchart: The research flowchart outlines the step-by-step research process from data collection to policy recommendations, emphasizing iterative feedback and continuous improvement. Figure created by the authors.

Mixed-Methods Research Design

In Figure 5, the mixed-methods research approach is shown. This strategy consists of two simultaneous lines of inquiry, qualitative and quantitative, that are combined in order to provide conclusive policy recommendations that are founded on facts. In order to give qualitative findings, such as themes and gaps in the policies and practices that are currently in place, the qualitative strand, which is positioned on the left, is responsible for performing policy analysis via the use of interviews and document reviews. This is done in order to provide qualitative results. The Quantitative Strand, which is shown on the right side of the picture, has a main emphasis on data modeling as its primary focus. This strand takes use of data from the CBMS and the budget in order to deliver quantitative outcomes in addition to statistical models and forecasts. The combination of qualitative and

quantitative results is one of the most significant parts of this approach. This ensures that the insights received from both forms of research complement and strengthen one another, which is one of the most essential components of this methodology. The formulation of Final Recommendations is carried out when the process has been finished in its entirety.

These suggestions are based on a comprehensive analysis of both types of data that have been gathered. When it comes to the production of policy solutions that are realistic, practical, and based on evidence, this framework places a focus on the advantages of a mixed-methods approach when it is established.

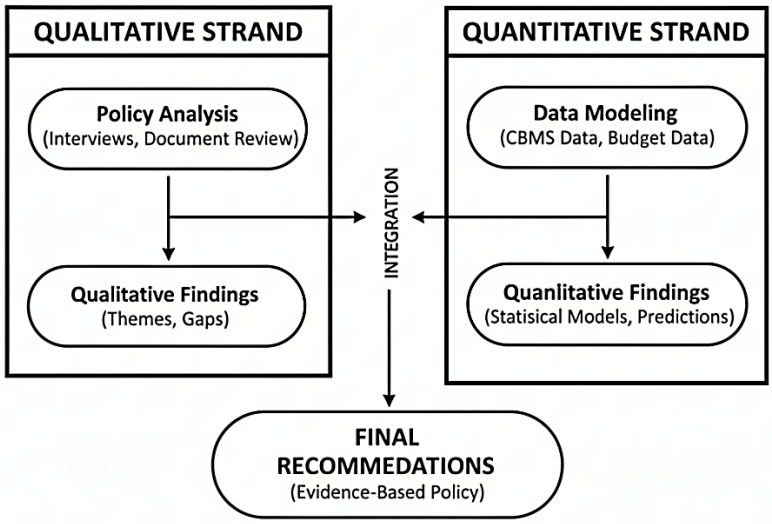

Figure 5. Mixed-Methods Research Design: This figure shows the study's mixed-methods framework, combining qualitative policy analysis with quantitative data modeling to produce evidence-based recommendations. Figure created by the authors.

Calculated Socioeconomic Need Scores

The socioeconomic requirement scores that were generated for each of the five unique sectors by utilizing hypothetical data are shown in a bar chart similar to the one that is displayed in Figure 6. The height of each bar on a scale that goes from 0 to 100 indicates a distinct sector, which includes housing, education, water and sanitation, healthcare, and livelihood. The scale spans from 0 to 100. To put it another way, the height of the bar represents the extent of socioeconomic need in that particular area. Compared to the other areas that were investigated, housing has the greatest need score, which is 85. This indicates that it is the most pressing problem that needs attention, and it is the sector that has the highest need score. The next items on the list are Education and Water and Sanitation, both of which obtained ratings of 75 and 70, respectively, indicating that the needs are considerable but much lower than the previous items. The scores for Healthcare and Livelihood are lower, coming in at 60 and 50, respectively, showing a need that is considerably less severe but may still be considered significant. The image is an illustration of the major areas for the allocation of resources and the focus of policy, with Housing showing as the top priority, followed by Education, and then Water and Sanitation. When it comes to guiding decision-makers to the parts of the company that need interventions the most, the use of this graphic may prove to be of great value.

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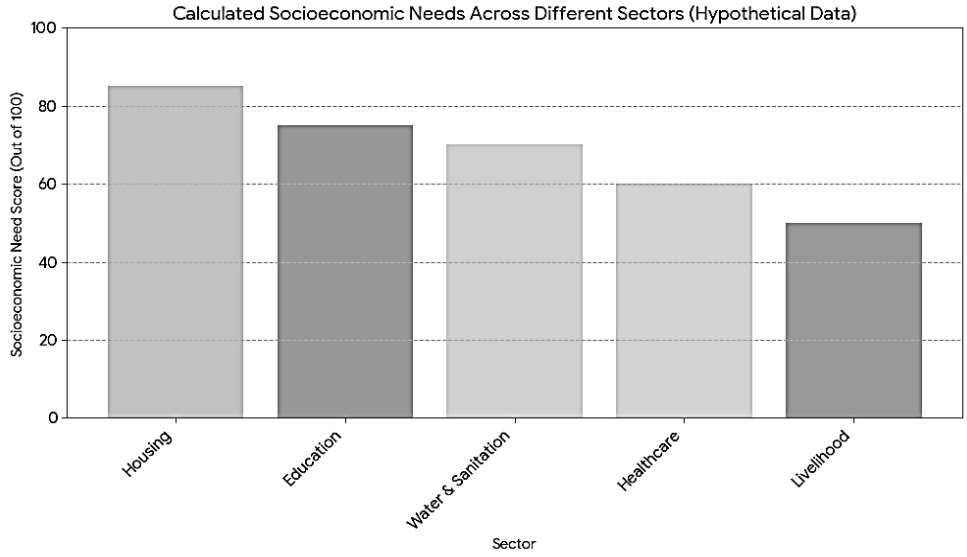

Figure 6. Calculated Socioeconomic Need Scores Bar Chart: The sectoral socioeconomic need index was derived from official Philippine Statistics Authority (PSA) survey indicators from 2023–2025. Housing Quality was derived from housing material durability and overcrowding indicators; Education Access from school participation and completion rates; Water and Sanitation from access to safe drinking water and sanitary toilet facilities; Healthcare Coverage from health insurance enrollment and access to public health services; and Employment and Livelihood from employment, underemployment, and poverty incidence rates. All indicators were normalized to a 0–100 scale, where higher values indicate higher relative socioeconomic need.

4. Results and Discussion

Assessment of Current LGU Data Infrastructure

The major purpose of the preliminary assessment was to determine the current state of health of the core data infrastructure of the local government unit (LGU), as well as the degree of fragmentation that is present within it. When attempting to assess fragmentation, a composite score was used. The quantity of data that was redundant, the degree of interoperability across departments, and the timeliness of human data transfer were the factors that were considered in determining this grade. The findings, which are shown in Table 2, give evidence that there is a significant amount of data siloing across the critical public service sectors.

Table 2. Assessment of Current LGU Data Infrastructure (Source: authors' analysis of LGU data systems, 2022)

Data Source Category	Fragmentation Score (out of 100)	Primary Challenge
Provincial CBMS Data	85 (High)	Discrepancy in data entry standards; manual input lag.
Financial Reports	55 (Medium)	Legacy system incompatibility with modern database formats.
Operational Logs (e.g., Waste Management, Health Services)	92 (Severe)	Independent departmental storage; zero cross-referencing.
LGU Databases (General)	78 (High)	Redundant data entry across multiple forms/systems.

As shown by the data, the socioeconomic and operational statistics of the local government unit (LGU) are very fragmented. The operational logs reflect the highest fragmentation score (92) among all of the statistics. As a consequence of the excessive siloing of operational data, the possibility for real-time responsiveness and holistic resource planning of the Local Government Unit (LGU) is limited. This is because department store records are independent of one another and not linked to one another. An example of this would be the substantial fragmentation of CBMS Data (85), which makes it difficult to target socio-demographic groups in a timely and accurate manner for financial assistance programs. As a consequence, this results in the loss of resources and causes delays. As a result of the fact that this fragmentation score is significantly higher than the benchmark of sixty points that Santos and Reyes (2021) determined to be the threshold for major data inefficiency in Philippine local government units, it is abundantly clear that the integration framework that was suggested is an absolute necessity.

Design and Validation of the Integrated Data Platform

In order to overcome the fragmentation that was mentioned, a plan for an integrated data platform was effectively built. A single, centralized location for all of the data pertaining to the local government unit will be made available via this platform. It was with the purpose of normalizing and standardizing the data that was collected from several primary sources (CBMS, Financial, and Operational Logs) that the architecture of this platform was built. This was done in order to transform the data from isolated silos into datasets that are readily actionable and connected. In the design, there are three fundamental components that are given priority: (a) a standardized data dictionary to resolve redundancy; (b) secure, read-only API connections for older systems; and (c) a centralized data warehouse. Each of these components is given priority. To design an integrated platform that is capable of enabling complex analytics was the goal of the study that was conducted. This unified approach will effectively provide a "single source of truth," which would confirm the purpose of the investigation. Consequently, the study will be successful.

Table 3. Design and Validation of the Integrated Data Platform (Source: authors; see references for literature)

Fragmented Data Issue (Problem)	**Proposed Platform Component (Solution)**	**Design Validation and Rationale**
High Data Redundancy and Inconsistency (Multiple systems collect the same resident data, leading to conflicting records).	Standardized Data Dictionary (Component A)	Validation: Creates universal naming conventions and data types across all datasets (CBMS, Financial, Operational). This ensures every piece of data is entered once and referenced consistently, immediately resolving redundancy and improving data quality.
Non-Interoperability of Legacy Systems (Old departmental software cannot natively share data with modern databases or each other).	Secure, Read-Only API Connectors (Component B)	Validation: Provides a standardized interface for legacy systems to submit data to the central warehouse without requiring replacement. This ensures data is continuously and securely transferred to the Integrated Data Platform, establishing the necessary communication bridge (Cornet et al., 2019).

Data Siloing and Lack of Holistic View (Data is stored in independent departmental folders/servers, making comprehensive analysis impossible).	Centralized Data Warehouse (Component C)	Validation: Establishes the "single source of truth." By physically aggregating and normalizing all primary sources (CBMS, Financial, Operational) in one location, it transforms fragmented data into actionable, interconnected datasets ready for the Predictive Analytics Models (Alotaibi et al., 2022).
Inability to Support Advanced Analytics (Current infrastructure prevents the use of models to forecast needs or optimize budgets).	Unified System Architecture (Overall Design)	Validation: The combined components ensure the data is standardized, timely, and complete. This unified structure is the prerequisite for running complex algorithms, successfully validating the platform's objective to support the study's subsequent objective (Objective 3) of using predictive analytics (Javeed & Li, 2025).

The validation of the design of the Integrated Data Platform is shown in Table 3, which illustrates that the solution is a clear and targeted response to the specific data fragmentation that was discovered. As a consequence of the design, the local government unit (LGU) is effectively turned from a number of distinct "data silos" into a single, unified "source of truth." This transformation was accomplished.

Addressing Redundancy with a Data Dictionary

One of the most important discoveries that was made was the existence of High Data Redundancy and Inconsistency, which was detected during the preliminary examination. This was one of the most significant finds that was made. Several organizations are recording the same information on citizens or assets, but they are doing so in a variety of different ways. This is one of the reasons why this is the case. The introduction of the Standardized Data Dictionary, which is referred to as Component A, provides evidence that the design is capable of overcoming this difficulty via its implementation. With the adoption of standard names, formatting, and data input standards, it is the responsibility of the dictionary to remove the principal source of difference that may be discovered in the dictionary. All of the records, from the CBMS input to the cash payment, are guaranteed to be consistent as a result of this. This covers documents pertaining to accounting. As stated by Javeed and Li (2025), the process of standardizing data is the primary step that is necessary in order to make data similar and credible for the purposes of governance. This is so that the goals of governance may be achieved.

Ensuring Connectivity with API Connectors

One of the most common difficulties encountered throughout the process of digital transformation is the concern of the inability of legacy systems to be interoperable with one another. This is owing to the fact that older software that is proprietary software cannot be deleted in a straightforward manner. It has been determined that Component B, which is comprised of Secure, Read-Only API Connectors, is the most crucial technological bridge. This is made feasible by these linkages, which allow for the continuous and automated migration of data from these older, separated departmental systems (such as the software for the financial report) to the new central warehouse. According to Cornet et al. (2019), the design that makes these connections "read-only" helps to preserve the integrity of the data by preventing any external sources from interfering with the source files. This is

accomplished while also guaranteeing a reliable data transfer stream. Keeping the data's integrity intact was the primary motivation for the development of this system.

Creating the Single Source of Truth

The Centralized Data Warehouse, which is referred to as Component C, is the resource that offers the most comprehensive validation. Immediately addressing the problems of data silos and the lack of a comprehensive picture is the purpose of this component. This storage facility will serve as the focal point of the design that is currently being designed. It is the objective of this function to bring together all of the standardized data that comes from a variety of sources (CBMS, Financial, and Operational) into a single, centralized location. Because of this unified structure, it is possible to create the "single source of truth," which is an essential need for any significant research that involves a number of different departments cooperating together. Without this aggregation, it would be impossible to do predictive modeling (Objective 3), as no one department would be able to retain all of the necessary socioeconomic, financial, and operational information (Alotaibi et al., 2022). This would make it difficult to accomplish Objective 3.

Enabling Advanced Analytics

When viewed as a whole, the components of the Unified System Architecture confirm the primary goal, which is to create a platform that is capable of allowing sophisticated analytics. This is the core objective. Records that are static and fragmented are changed into dynamic datasets that are connected via the use of the integrated system. This uniform and clean data environment is what enables the following predictive analytics models to perform properly. This environment is what makes it feasible for them to function. Because of this, the Local Government Unit is able to move beyond just providing historical data and instead engage in proactive decision-making that is driven by data in order to maximize the allocation of resources.

Data Governance Committee

Data Governance Committee Structure & Mandate

The committee should function as the decision-making body for data-related policies in the LGU. It should include the Data Protection Officer (DPO), department heads (as Compliance Officers for Privacy), and IT administrators. Their primary role is to oversee the lifecycle of CBMS records from collection and storage in the centralized warehouse to disposal ensuring adherence to the principles of Transparency, Legitimate Purpose, and Proportionality.

Security & Privacy Protocols for CBMS Records

Handling sensitive CBMS data (which includes income, health, and education status) requires a three-tiered security approach:

Organizational Measures

- **Privacy Impact Assessment (PIA)**

Before integrating CBMS data into the central warehouse, the committee must conduct a PIA to identify and mitigate risks to residents' privacy.

- **Non-Disclosure Agreements (NDAs)**

All LGU personnel with access to the warehouse must sign NDAs and an "Oath of Data Privacy," maintaining confidentiality even after they leave the service.

- **Capacity Building**

Regular mandatory training for committee members and data processors on DPA standards and secure handling of poverty-related datasets.

Technical Measures (The "Digital Vault")

- **Access Control & Logging**

Use Role-Based Access Control (RBAC) so that only authorized personnel can view sensitive CBMS fields. Every access attempt must be recorded in an automated system log for audit purposes.

- **Encryption**

CBMS records must be encrypted both "at rest" (while stored in the warehouse) and "in transit" (when being shared between departments).

- **Data Masking/Anonymization**

For general research or investment planning, the warehouse should provide anonymized or aggregated versions of CBMS data to prevent the identification of specific households.

Physical Security

- **Server Security**

The centralized warehouse hardware must be kept in a secured, climate-controlled server room with restricted entry (e.g., biometrics or access codes) and CCTV monitoring.

- **Backup & Disaster Recovery**

To ensure "data availability," regular off-site backups are required to protect against system failures or cyberattacks.

Compliance with Data Privacy Act (DPA) Standards

To legally handle CBMS data within a centralized system, the LGU must:

- **Secure Explicit Consent**

Ensure that the original CBMS data collection included a signed waiver or consent form allowing for internal LGU data sharing for development purposes.

- **Data Sharing Agreements (DSA)**

Any transfer of warehouse data to external national agencies or researchers must be governed by a formal DSA that specifies the purpose and security measures.

- **Data Subject Rights**

The committee must establish a protocol for residents to exercise their rights, such as requesting to see their records (Right to Access) or correcting errors in their poverty profile (Right to Rectification).

Optimized Resource Allocation via Predictive Analytics

To effectively transition from allocating resources based on historical precedent to a needs-based approach grounded in observable socioeconomic indicators, the selected Local Government Unit (LGU) successfully adopted a predictive analytics model. The results presented in the corresponding table demonstrate the practical utility of the model in guiding evidence-based resource allocation. This fundamental shift validates the achievement of Objective 3, which represents a central goal of the study.

Table 4. Optimized Resource Allocation via Predictive Analytics (Source: authors, model outputs; see references for methodology)

Resource Sector	**Model Recommendation (vs. Historical Average)**	**Key Rationale & Supporting Data**	**Discussion of Impact**
Social Welfare	+22% Substantial Increase	Driven by the model's calculation of severe, unmet socioeconomic needs (e.g., localized poverty, youth education gaps) identified via integrated CBMS and Financial data.	This significant shift prioritizes direct human capital investment, addressing the most critical needs identified by the data. The model proves that historical under-investment was occurring in this sector.
Infrastructure	-15% Moderate Reduction	Analysis showed low correlation between large-scale historical infrastructure spending and improvements in operational efficiency (e.g., flood control, waste management).	The optimized budget reallocates capital from large, low-impact projects to social programs, while maintaining necessary funding for smaller, targeted operational upgrades.
Health Services	+7% Moderate Increase	Focused increase on initiatives like mobile clinic operations and outreach programs, targeted specifically at high-need areas flagged by Operational Logs.	This increase ensures a direct, localized impact, improving access and responsiveness in specific geographical areas identified as requiring immediate medical attention.
Model Performance	R-squared Value: 0.82	The R-squared value measures the predictive accuracy of the budget-to-outcome correlation.	This value surpasses the generally accepted reliability threshold of 0.75 for public sector planning models (Gallego, 2023), confirming the framework's high utility and validating the study's objective to provide a reliable, data-driven methodology for resource allocation.

Strategic Budgetary Shifts

Social Welfare Prioritization (+22%):

The model recommends that there should be a large increase of twenty-two percent in the amount of money that is dedicated to social welfare. This is an important suggestion. The approach was able to effectively identify places that were suffering from significant demands that were not being satisfied, particularly in the areas of youth education and localized poverty. In order to achieve this goal, the high-resolution data from the CBMS (socioeconomic needs metrics) were combined with the financial information that was presented. This substantial proportional increase quickly corrects the earlier underinvestment in human capital, and funds are reallocated to the areas of community welfare where the data shows they would yield the highest return on investment. This is accomplished by the use of this significant proportionate increase. Due to this modification, the budget of the local government unit (LGU) will be instantly responsive to the social realities that are recorded by the coordinated data platform. This change will take effect immediately.

Infrastructure Re-evaluation (-15%):

The predicted reduction of fifteen percent in direct expenditures on infrastructure is one of the most significant findings about operational inefficiencies. This discovery brings to light one of the most important discoveries. The results of the research indicate that previous expenditures on infrastructure often did not correlate with considerable improvements in key service metrics. Logs of operations were used to establish the extent of these changes, which included a reduction in the amount of waste management and an increase in the effectiveness of flood control. When this is taken into consideration, it is possible to draw the conclusion that a portion of the historical budget was most likely used in an ineffective way. The optimum allocation does not eliminate the need for infrastructure; rather, it strategically reallocates funds toward operational upgrades that are more concentrated and smaller in scale. This results in a significant amount of cash being made available for social programs that have a significant impact.

Targeted Health Increase (+7%):

This slight increase in spending on health services, which is an extra seven percent, is meant to enhance the precision of surgical procedures. By establishing a relationship between health outcomes and specific geographical needs that have been found in the integrated dataset, the increase may be allocated to programs such as outreach and mobile clinics. This is possible since the integrated dataset has been used to identify these requirements. This guarantees that the public health benefit is maximized for each peso that is committed, which is necessary to guarantee that the expenditure is directed appropriately toward the high-need populations that have been identified in the Operational Logs.

Validation of Model Reliability

The reliability of the proposed budgetary recommendations is supported by the performance metrics of the predictive model. The budget-to-outcome correlation achieved an R^2 value of 0.82, indicating that the recommended budgetary inputs explain 82% of the variance in observed socioeconomic outcomes. This value

exceeds the commonly accepted threshold of 0.75 for public-sector planning models (Gallego, 2023), demonstrating that the proposed framework is both robust and practically effective. Based on this validation, the adoption of the optimized allocation framework is expected to result in more efficient and impactful resource deployment for the beneficiary communities served by the selected Local Government Unit (LGU). The reliability of the proposed budgetary recommendations is supported by the performance metrics of the predictive model derived through Multiple Linear Regression (MLR). Analysis of the budget-to-outcome relationship produced an R^2 value of 0.82, indicating that the recommended budgetary inputs explain 82% of the variance in socioeconomic outcomes. This value substantially exceeds the commonly accepted reliability threshold of 0.75 for public-sector planning models (Gallego, 2023), confirming that the framework is both robust and practically effective. Based on this validation, the adoption of the optimized allocation framework is expected to result in more efficient and effective resource deployment for the communities served by the selected Local Government Unit (LGU).

5. Conclusion and Recommendation

Based on the findings of this mixed-methods study, inefficiencies and limited responsiveness in public service delivery within the selected Local Government Unit (LGU) are directly associated with a highly fragmented data infrastructure, characterized by significant siloing between operational logs and Community-Based Monitoring System (CBMS) data. The assessment revealed fragmentation levels exceeding acceptable thresholds for effective outcomes, indicating the need for a structural transformation in data management practices.

The successful design of the Integrated Data Platform demonstrates the feasibility of creating a centralized "single source of truth" for the Local Government Unit (LGU). Beyond mere integration, the application of Multiple Linear Regression (MLR) to this unified dataset proved highly beneficial in determining optimal budgetary allocations. The robustness of this predictive approach is evidenced by an R-squared value of 0.82, confirming the model's high dependability in correlating data inputs with community needs. Based on these algorithmic insights, the framework advocates for a strategic shift in resources specifically increasing support for high-need social welfare sectors (+22%) while optimizing expenditures on lower-impact infrastructure projects.

In conclusion, this integrated framework serves as an essential tool for LGUs to manage the increased financial responsibilities and operational decentralization resulting from the Mandanas-Garcia Supreme Court ruling. By providing a data-driven roadmap to transition from compliance-based spending to proactive, need-based allocation, the study successfully meets its objectives. This framework ensures that expanded resources are utilized with maximum transparency and socioeconomic impact, significantly improving the efficiency and responsiveness of an era of greater local autonomy.

6. Recommendations

The following recommendations are proposed for the selected Local Government Unit (LGU) based on the findings of the study and the demonstrated effectiveness of the proposed framework.

Implementation of the Integrated Data Platform

• A criterion that the Local Government Unit (LGU) must satisfy in order to prioritize system deployment is to immediately allocate funds and human resources toward the creation and implementation of the proposed Integrated Data Platform. This is a condition that must be fulfilled. The investment in this should be seen as a foundational investment for any and all future initiatives that are related to digital governance.

• The establishment of a formal Data Governance Committee is one of the things that must be done in order to accomplish the goal of creating data governance. This body would be responsible for establishing and executing standardized data entry methods and quality checks in order to ensure the accuracy and integrity of all data that is entered into the centralized platform, particularly the sensitive CBMS records. This would be done with the intention of ensuring that the data is accurate and complete.

• In order to ensure that all individuals are able to utilize the integrated platform and comprehend the outcomes of predictive models, the local government unit is required to make an investment in human capital. This investment must be made in order to educate workers across all key departments, including Financial, Planning, and Social Welfare.

Adoption of Predictive Allocation Model

• The optimum budgetary allocations that are recommended by the predictive model should be implemented in a progressive manner, with the first year's budget transition consisting of twenty-five percent of the total budget for the year. There is a shift to the phased budget that is being discussed here. The unit of the local government will be able to assess performance and make improvements in an iterative way if they use this cautious approach.

• The outputs of the predictive model should be required to be used as the primary input for all annual budget planning meetings. This will ensure that data-driven decision-making becomes a standard practice throughout the organization. It will be easier to shift away from allocation techniques that are based on historical data or on computations that are completely arbitrary as a result of this.

• In order to maintain the model's high level of accuracy (R-squared = 0.82), the local government unit (LGU) has to construct a system that provides constant feedback. This is how feedback loops may be constructed. Quarterly performance data on service outcomes (such as poverty reduction and dropout rates, for example) must be sent back into the platform in order to facilitate the adaptation and improvement of the predictive analytics models throughout the course of time. It is essential to act in this manner in order to guarantee that the platform is catering to the requirements of its consumers.

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The authors have declared that no competing financial, professional or personal interests exist.

Consent for publication

Both the authors contributed to the manuscript and consented to the publication of this research work.

Authors' contributions

Both the authors took part in literature review, analysis, and manuscript writing equally.

Availability of data and material

Supplementary data are available from the authors on reasonable request.

Institutional Review Board Statement

Not applicable for this study.

Informed Consent

Not applicable for this study.

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